

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

• Line

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

**CLAIMS:**

1. A rotary hydraulic machine comprising a housing, a rotating group within said housing including a barrel and a plurality of pistons slidable within cylinders formed in said barrel, a swashplate operable upon said pistons to induce reciprocation thereof in respective ones of said cylinders to transfer fluid between an inlet port and an outlet port as said barrel rotates, and an actuator operable upon said swashplate to adjust the disposition thereof relative to said housing and thereby vary the stroke of said pistons in said cylinders, said swashplate having a bearing surface engagable with a complementary surface on said housing and a fluid bearing interposed between said surfaces.
2. A rotary hydraulic machine according to claim 1 wherein said fluid bearing is supplied with fluid from one of said ports.
3. A rotary hydraulic machine according to claim 2 wherein said fluid is supplied through a pressure compensating flow control valve to maintain a predetermined flow of fluid as pressure at said port varies.
4. A rotary hydraulic machine according to claim 3 wherein said fluid bearing includes a pair of recesses formed between said surfaces and fluid is supplied to each of said recesses.
5. A rotary hydraulic machine according to claim 4 wherein said recesses are generally aligned with said ports.
6. A rotary hydraulic machine according to claim 5 wherein said recesses are of differing areas to balance forces imposed on said swashplate by connection of said pistons to respective ones of said ports.

7. A rotary hydraulic machine according to claim 1 wherein at least one of said surfaces has a coating applied thereto to reduce friction between said surfaces.
  8. A rotary hydraulic machine according to claim 7 wherein said coating is applied to said bearing surface.
  9. A rotary hydraulic machine according to claim 7 wherein said coating is a polymer.
  10. A rotary hydraulic machine according to claim 9 wherein said polymer is a nylon.
  11. A rotary hydraulic machine according to claim 10 wherein said nylon is formulated from a type II polyamide resin.
  12. A rotary hydraulic machine according to claim 1 wherein said bearing surface is part cylindrical.
  13. A rotary hydraulic machine according to claim 12 wherein said bearing surface is coated with a polymer to reduce friction between said surfaces.
  14. A rotary hydraulic machine according to claim 12 wherein fluid is supplied to said fluid bearing from one of said ports.
  15. A rotary hydraulic machine according to claim 14 wherein said fluid is supplied through a pressure compensated flow control valve to maintain a predetermined flow of fluid as pressure at said port varies.
  16. A rotary hydraulic machine according to claim 12 wherein said swashplate has a planar surface oppositely directed to said bearing surface and said pistons bear against said planar surface.
-

17. A rotary hydraulic machine according to claim 1 wherein each of said pistons includes a slipper secured to a piston body by a universal joint, said slipper engaging said planar surface to slide relative thereto as said barrel rotates.
  18. A rotary hydraulic machine according to claim 17 wherein said planar surface is provided by an annular insert located within a body of said swashplate.
  19. A rotary hydraulic machine according to claim 18 wherein said slippers are maintained in contact with said planar surface by a retaining plate having apertures therein to accommodate said pistons and clamps secure said retaining plate to said swashplate body.
  20. A rotary hydraulic machine according to claim 1 wherein said actuator includes a pair of motors acting at spaced locations on said swashplate.
  21. A rotary hydraulic machine according to claim 20 wherein said motors engage said swashplate on opposite sides of its centre of rotation.
  22. A hydraulic machine according to claim 20 wherein said swashplate includes a body having a part cylindrical bearing face and on oppositely directed planar face engaged by said pistons with said part cylindrical bearing face defining an axis of rotation of said swashplate, said motors engaging said planar face on opposite sides of said axis of rotation to impart rotation in opposite directions to said swashplate.
  23. A hydraulic machine according to claim 22 wherein each of said motors comprises a linear motor having a working piston extendible from an actuator cylinder upon application of fluid pressure to said motor.
-

24. A hydraulic machine according to claim 23 wherein each of said working pistons engages a convex abutment protruding from said planar face to provide a rolling engagement of said working piston over said abutment as said swashplate rotates.
25. A rotary hydraulic machine comprising a housing, a rotating group within said housing including a barrel and a plurality of pistons slidable within cylinders formed in said barrel, a swashplate operable upon said pistons to induce reciprocation thereof in respective ones of said cylinders to transfer fluid between an inlet port and an outlet port as said barrel rotates, and an actuator operable upon said swashplate to adjust the disposition thereof relative to said housing and thereby vary the stroke of said pistons in said cylinders, said swashplate including a body having a part cylindrical bearing face and on oppositely directed planar face engaged by said pistons with said part cylindrical bearing face defining an axis of rotation of said swashplate, said actuator including a pair of motors each engaging said planar face on opposite sides of said axis of rotation to impart rotation in opposite directions to said swashplate.
26. A hydraulic machine according to claim 25 wherein said motors are disposed parallel to and spaced from the axis of rotation of said barrel in said housing.
27. A hydraulic machine according to claim 26 wherein each of said motors comprises a linear motor having a working piston extendible from an actuator cylinder upon application of fluid pressure to said motor.
- 

28. . A hydraulic machine according to claim 27 wherein each of said working pistons engages a convex abutment protruding from said planar face to provide a rolling engagement of said working piston over said abutment as said swashplate rotates.

29. A hydraulic machine according to claim 28 wherein said abutments are provided by cylindrical pins inserted in to part cylindrical recesses in said body.
30. A hydraulic machine according to claim 29 wherein said housing includes a casing having a complementary bearing surface to receive said body of said swashplate and said motors are secured to said casing to act between said casing and said swashplate..
31. A hydraulic machine according to claim 30 wherein said motors are each secured in bores in said casing.
32. A hydraulic machine according to claim 31 wherein said motors each include an actuator cylinder and a working piston extending from said actuator cylinder, said actuator cylinder being secured to a respective one of said bores.
33. A hydraulic machine according to claim 30 wherein a fluid bearing acts between said bearing surfaces.
34. A hydraulic machine according to claim 33 wherein fluid is supplied to said fluid bearing by a flow control valve to maintain a predetermined flow rate to said bearing.
35. A hydraulic machine according to claim 34 wherein fluid is supplied from one of said ports to said fluid bearing and said flow control valve is pressure compensated to maintain said predetermined flow rate as said pressure at said port fluctuates.
36. A hydraulic machine according to claim 35 wherein said fluid bearing includes a pair of recesses in at least one of said surfaces to receive pressurised fluid .
- 
37. A hydraulic machine according to claim 36 wherein said recesses are aligned with respective ones of said ports.

38. A rotary hydraulic machine according to claim 37 wherein at least one of said surfaces has a coating applied thereto to reduce friction between said surfaces.
39. A rotary hydraulic machine according to claim 38 wherein said coating is applied to said bearing surface.
40. A rotary hydraulic machine according to claim 39 wherein said coating is a polymer.
41. A rotary hydraulic machine according to claim 40 wherein said polymer is a nylon.
42. A rotary hydraulic machine according to claim 41 wherein said nylon is formulated from a type II polyamide resin.
43. A rotary hydraulic machine comprising a housing, a rotating group within said housing including a barrel and a plurality of pistons slidable within cylinders formed in said barrel, a swashplate operable upon said pistons to induce reciprocation thereof in respective ones of said cylinders to transfer fluid between an inlet port and an outlet port as said barrel rotates, a bearing assembly to support said swashplate in said housing for rotation relative to said housing about an axis and an actuator operable upon said swashplate to adjust the disposition thereof relative to said housing and thereby vary the stroke of said pistons in said cylinders, said swashplate including a body having a planar face engaged by said pistons and a pair of convex abutments protruding from said planar face, and said actuator including a pair of motors each engaging a respective one of said convex abutments on said planar face on opposite sides of said axis of rotation to impart rotation in opposite directions to said swashplate, said convex abutments providing a rolling engagement of said motors on said swashplate as said swashplate is adjusted.

44. A hydraulic machine according to claim 43 wherein said motors each include a working piston engagable with a respective one of said abutments.
45. A hydraulic machine according to claim 44 wherein said abutments are provided by cylindrical pins received in part cylindrical bores in said swashplate.
46. A hydraulic machine according to claim 45 wherein said bearing assembly includes a part cylindrical bearing surface on said swashplate oppositely directed to said planar surface and a complementary surface in said housing to define said axis of rotation.
47. A hydraulic machine according to claim 46 wherein a fluid bearing is interposed between said surfaces.
48. A rotary hydraulic machine according to claim 46 wherein at least one of said surfaces has a coating applied thereto to reduce friction between said surfaces.
49. A rotary hydraulic machine according to claim 48 wherein said coating is applied to said bearing surface.
50. A rotary hydraulic machine according to claim 49 wherein said coating is a polymer.
51. A rotary hydraulic machine according to claim 50 wherein said polymer is a nylon.
52. A rotary hydraulic machine according to claim 51 wherein said nylon is formulated from a type II polyamide resin.
53. A hydraulic machine according to claim 44 wherein said working pistons are slidably received in an actuator cylinder secured to said casing.
- 
54. A hydraulic machine according to claim 53 wherein said actuator cylinder is located in a bore in said housing.